The Freescale Cup
2011-2012 Season Rules
EMEA

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Overview

All racing teams will use the car model suite designated by Freescale Semiconductor. The MPC5604B Microcontroller Board from Freescale Semiconductor is the core control unit. The teams should design the software control scheme and racing car system hardware themselves. The software includes sensor imaging collection and processing, drive motor control, and steering motor control algorithm development. The teams are required to design motor control hardware as well as the sensor interface hardware (based on CMOS Camera sensor).

The judging committee of the event will rank using the racing rules contained in this document for the preliminary round and the final competition. Equality and fairness will be ensured as much as possible. The Freescale Cup committee will invite guest judges to supervise the racing as well during the competition.

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Section 1: Team Rules and Requirements

1. Only undergraduate students from an invited University may participate (High School degree +3 or 4 years of university depending on country). Master or PhD students are not eligible for this program
2. Each school may have up to 3 racing teams to be represented to the official Freescale competitions. School internal competitions can be discussed on a case by case basis only
3. The maximum number of people on a team is 3.
4. Cars will be designed and constructed by students only. This includes the car chassis, external circuitry, software development, etc.
5. Students are required to submit a final report regardless of participation in the racing event.
6. Participants are expected to exhibit good sportsmanship. Any inappropriate behavior or cheating may result in disqualification.

Section 2: Equipment Requirements

Each team will be provided the same basic kit of parts. The following rules are in place to keep the playing field level. The spirit of the game is demonstration of excellent hardware integration and superior programming.
1. The following original and unaltered equipment must be used in the design.
   a. Tires
   b. Drive - DC motor
   c. Transmission Ratio of Drive Motor
   d. Servo Motor
      i. Excludes connection component on output axis of the rudder
   e. Battery (7.2V, 2400mAh)
      i. Only one (1) battery at a time may be used to power the vehicle and hardware
   f. If any standard component of the car model is damaged, then a replacement part of the same model should be used.
2. The chassis can be modified, with some restrictions:
      i. The footprint of the frame may not be altered
      ii. You may not change the distance between wheels
      iii. No part of the car shall exceed dimensions of 250mm/9.85in (W) x 400mm/15.75in (L)
      iv. You may drill holes or install auxiliary racks on the chassis
3. Additional external circuitry and sensors will be necessary
4. The main control board may be modified.
5. Teams are allowed to create custom control boards.
6. No auxiliary processor or other programmable device is allowed besides the MPC5604B microcontroller.
7. DC-DC boost circuit cannot be used to power drive or steering motors.

8. Total capacity of all capacitors should not exceed 2000 uF; the highest charging voltage of capacitors should not exceed 25 V.
9. The following limits on hardware will be enforced per vehicle:
    a. One (1) microcontroller in the control board
    b. Maximum of three (3) servos
    c. Maximum of sixteen (16) sensors
        i. CMOS camera sensor is 1 sensor
10. Teams must use one of the following camera options:
    a. Parallax TSL1401-DB
    http://www.parallax.com/Store/Sensors/ColorLight/tabid/175/CategoryID/50/List/0/SortField/0/Level/a/ProductID/566/Default.aspx
    b. LinkSprite LS-Y201
    http://www.junetrading.com/product_info.php?products_id=5785
    c. Toshiba TCM8240MD RB-Spa-115
    http://www.robotshop.com/sfe-cmos-camera-1300-1040.html
    d, CM-26N
    http://www.sparkfun.com/commerce/product_info.php?products_id=8739
11. Teams must use one of the following motor control options:
    a. Freescale H-Bridge such as MC33931or MC33932
    http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=MC33931&fsrch=1&sr=2
    b. Discrete analog components
12. The software shall be created using CodeWarrior Development Tools and Rappid Initialization for Power Architecture.
13. NO REPRODUCTION IS ALLOWED IN DESIGN OF THE CAR MODEL. HARDWARE AND SOFTWARE OF CAR MODELS OF COMPETING TEAMS WITHIN SAME UNIVERSITY SHOULD BE ORIGINAL AND CLEARLY DIFFERENT.

Section 3: Referee and Technical Judgment

The Freescale Cup will be carried out by the undertaking universities under direction of the organizing committee of the event.

1. The submission of a Technical Report is mandatory to continue in the competition. Teams that do not turn in a Technical Report by the specified date will be disqualified and must return the provided hardware to Freescale.
2. During the race, a group of the organizing committee will perform a technical inspection for all entries. This includes vehicle specifications, dimensions, and non-modifiable parts. In the event of any violations, the organizing committee is entitled to disqualify the corresponding team.
3. The referees are responsible for on-track activities. This includes race track management such as starting and stopping vehicles, as well as timing and

scorekeeping.

4. The judges are responsible for non-time based judging activities. This includes design judging and/or report judging.

5. Any racing disputes will be taken up and resolved by the racing executive committee.

6. Workers of the organizing committee or the event team shall not participate in coaching or training for any specific racing team (except for microcontroller training) and shall not disclose any information that might compromise fairness of the competition.

Section 4: Race Day Competition Procedure

1. The morning of the race, each racing team can test the track environment on site. The test racing track is different from the actual racing track in shape but their material and environment will be the same. Final calibration may be made at this time.

2. Before competition begins, all cars will be collected and held by the organizing committee until end of the competition. During this time, the teams are not allowed to modify software or hardware of the car.

3. The entire racing event is divided into two rounds: preliminary (qualifying) and the final competition.

4. A referee will direct all the racing teams when to enter the playing field in accordance with the racing order.

5. There shall be only one team on the track at any given time.

6. After being called by a referee, each racing team should designate a member to take their racing car to the playing field and place it in the starting area of the racing track.

7. Upon entering the playing field, a team has two minutes to set up the car and signal "Ready" to referee.

8. After the referee announces the start of the race, the vehicle should leave the starting area within 30 seconds and run for two laps.

9. After the race car finishes, a member of the team shall take the vehicle away from the track.

10. Event displays will post the best time for a single lap.

Section 5: Preliminary (Qualifying) Race

1. Race order will be determined by random drawing.

2. Each team is given two attempts to complete the track and post a time.

3. Teams that cannot complete the track after two attempts do not advance to the finals.

4. If there are multiple tracks, teams cannot use the same track for the second attempt.

5. The vehicle must complete two laps on the racing track.

6. The shortest time for a single lap will be recorded.
7. Based on the number of participating teams, the organizing committee of the event may set a certain limit of racing teams that can advance to the finals based on the best times in preliminary.
8. The technical judges will perform on-site technical inspection for all the cars eligible for the final.
9. Disqualified cars will be replaced by the next car in ranking.
10. List of finalists will be submitted by the referees to the organizing committee of the event.
11. After the preliminary round, the car hardware or software can be improved in compliance with competition rules. Changes must be reported in the Technical Update Sheet.

Section 6: Final Race

1. The teams will be sequentially ordered based on preliminary times.
2. Teams with slowest times compete first in the finals.
3. If there are multiple tracks, the race track configuration for the final is to be different from that used for preliminary. This can include shape, size, and distance.
4. Each finalist has one attempt to complete the track.
5. Each vehicle must complete two laps.
6. The shortest time taken to run a single lap will be taken as the final score of the racing car.
7. The score in the preliminary will not be included in the score of the final.

Section 7: Rules for Fouls and Disqualifications

The rules will be interpreted by Freescale and the organizing committee of the event.

1. During a team's racing, the on-site referee will judge whether the racing car ran out of the race track according to applicable rules.
2. If a race car has 3 wheels off the track or runs completely off the track, the score of the current lap will be considered invalid.
3. Any of the following conditions will be considered as a foul and will result in time penalty added:
    a. The race car fails to leave the starting area within 30 seconds after beginning of the race [+1 second].
    b. The race car fails to stop 3 meters after the finish line, after completing the 2 laps [+1 second].
4. Any of the following conditions will be considered a failure and no time will be given:
    a. The race car runs off of the track 2 times (1 time/lap).
    b. The racing team fails to enter the playing field and get prepared for the

racing in two (2) minutes after being called by the referee.

   c. The player touches the racing car after the beginning of the race without consent of the referee.

   d. The racing car fails to finish 2 laps within 120 seconds after leaving the starting area.

5. No time will be given for a disqualified team. Any of the following conditions will be considered a disqualification:

   a. Any auxiliary lighting equipment or other auxiliary sensors around the race track.

   b. Modification of the hardware or software after the race has begun except for changing the battery.

   c. More than one team member in the playing field.

   d. Any behavior that might interfere with the movement of the car.

   e. Any cheating during the competition.

   f. Plagiarizing the car design including hardware or software. Cars from the same University but different teams must be clearly different.

   g. Failure to pass the technical inspection.

Section 8: Scoring

1. Equality and fairness will be ensured as much as possible on the condition of actual feasibility. Disputes will be resolved by a vote of organizing committee and judges.
2. Time starts when the racing car crosses the start/finish line.
3. Fouls will result in the time addition to the car's lap time.
4. Disqualifications and Failures will result in no score.
5. Time will be captured using an electronic gate or handheld timer.
6. Car design judging will be scored on the quality of construction, appearance, and design creativity.
7. Technical report judging will be scored on quality of content, design approach, and concept understanding.
8. The score from the preliminary round will not be included in the score of the final round.
9. The final score shall be determined by the final time of the racing car and the technical and quality content of the final report.
10. The race time will be converted to a point system with the fastest car receiving the most points.

Section 9: Awards

The sum of the team's points for race rank, report, and design judging will determine the final rank. Awards will be given to the top three teams who have the highest rank.

Section 10: Technical Report Requirements

Technical reports will be reviewed and rated by the experts invited by the organizing committee of the event. Technical reports should be clear with detailed text, diagrams, and bibliography. Technical reports must contain a brief description of major concepts and specific technical implementation schemes for design and production of car models including:

1. Description of mechanical design of car model
2. Description of control circuit design
3. Description of the electronics design
4. Description of control software design
5. Total weight and dimensions of the reengineered car
6. Power consumption
7. Count and type of sensors used
8. Number of servo motors besides the existing driving motors and rudder motors of the car model
9. Written in English
10. Formatted for either Microsoft Word or PDF
11. Submitted via email to the Freescale contact two weeks prior to the race

Upon arrival at the final competition, each team must submit a CD, complete with the University Name and Team Name, with the following content:

a. The Technical Report previously submitted via email.
b. A technical update document reporting changes or improvements in the car prototype and software since the technical report was submitted.
c. All related raw documents like mechanical design, circuit design, and MCU software project of car models.

Section 11: Parameters of the Racing Track

1. Each University should create their own test track for the students to use during development. Track templates are provided on the CD.
2. The actual layout of the final racing track will be unknown to competitors until competition day.
3. For a limited time on race day, a test track made from the same material will be available on a first come, first serve basis for calibration and design modifications.
4. Width of the racing track shall not be less than 600mm/23.65in.
5. Material specifications regarding the surface of the racing track will be provided on the web site of the event.
6. Surface of the racing track is matte white, with a continuous black line (25mm/1in wide) drawn in the middle as the pilot line.
7. The minimum bending radius of the racing track shall not be less than 500mm/19.7in.

8. The racing track can intersect with a crossing angle of 90°.
9. Any slope in the track will be equal to or less than 15 degrees in a straight section of the racing track, including upgrade and downgrade.
10. There is a straight starting area of 1000mm/39.4in long in the racing track, as shown in figure below. In addition, there is a black starting line 100mm/3.9in long at both sides of the starting point. Start time and end time will be determined when the front part of the racing car passes the starting line. The car must be able to automatically stop within three meters of the starting line after finishing the race.
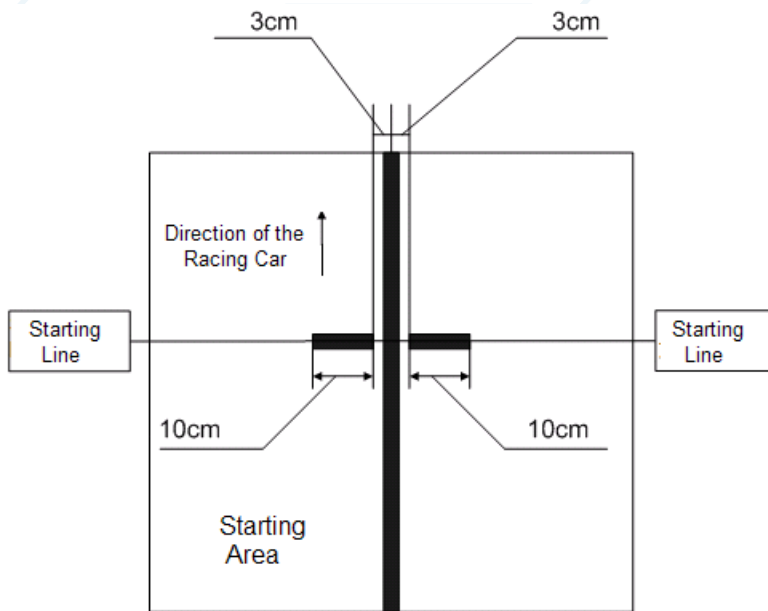
The rules and conditions are subject to change by Freescale if necessary. Freescale reserves the right in their sole discretion to cancel, suspend and/or modify The Freescale Cup race at any time. These official rules are drawn up in the English language. If these official rules are provided in any other language and there is a conflict in the text, the English language text shall prevail.

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